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(54) **Animal feeds**

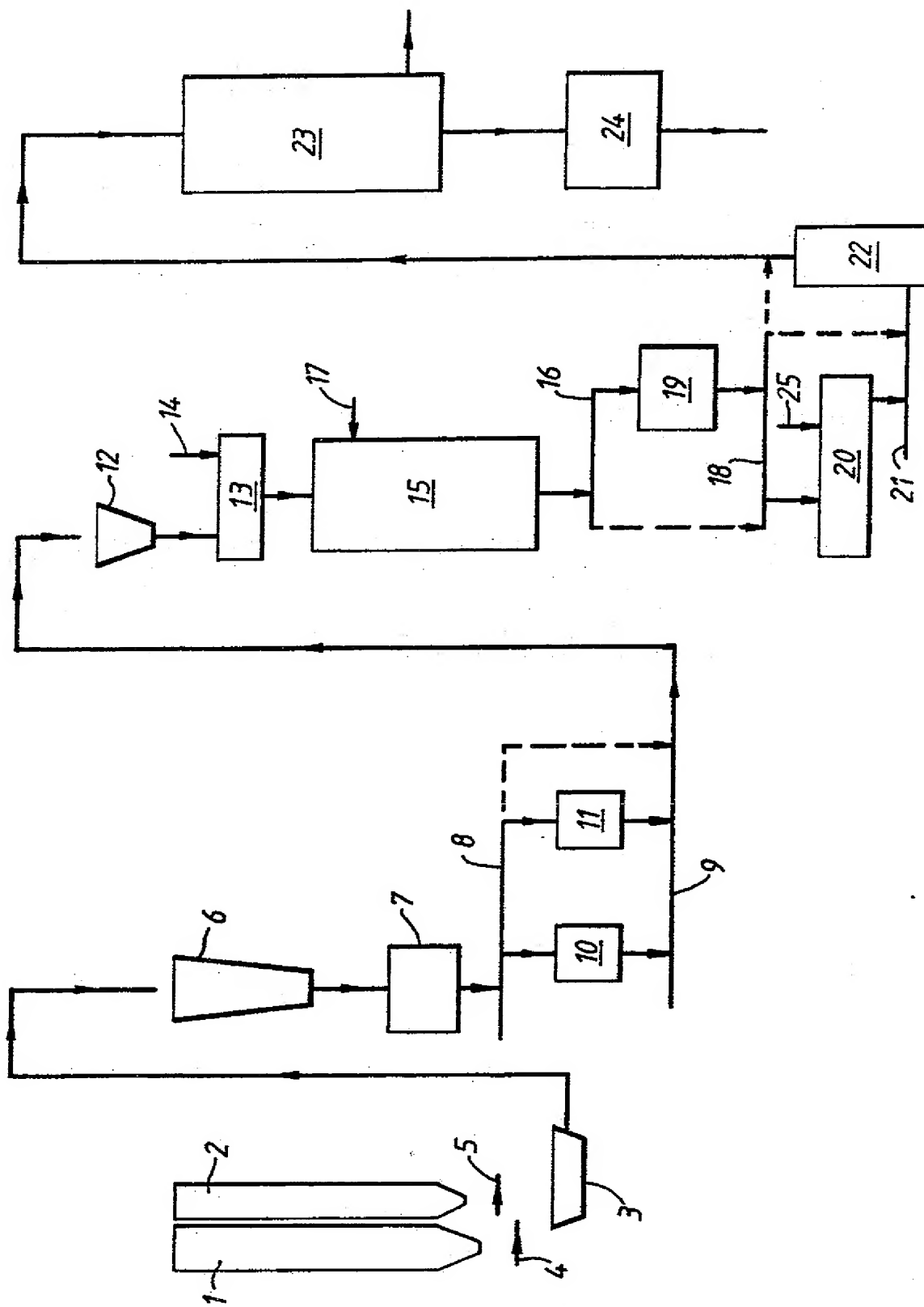
(57) Wet cooked animal feeds are made from oilseeds, pulses and/or cereals, by first passing the raw feed through a cracking roll (7) before wet cooking (15). The cracking roll cracks the shells of any oilseeds but without releasing all the oil, and this facilitates subsequent cooking and oil release. Pulses and cereals are reduced in size by the cracking roll which also facilitates cooking and further treatment. The process enables new feeds to be made comprising 100% full fat wet cooked oilseeds, and mixtures thereof with cereals and pulses, and also wet cooked cereal and pulse flaked products.

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1990.

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ANIMAL FEEDS

This invention relates to animal feeds and, more particularly, to cooked animal feeds made from oilseeds (including lentils), pulses and/or cereals, and to a method of making the feeds.

It is known to manufacture animal feeds from oilseeds, pulses and/or cereals by a process which includes a wet cooking step. This cooking serves a number of purposes, including the removal or significant reduction of antinutritional factors which may be present in the raw materials, and also the improvement of the digestibility of the materials. In the case of feeds containing oilseeds, there are some further problems. Firstly, it is important to release the oil from the seeds since intact seeds in the final product will be of no nutritional value to the animal. Secondly, if the seeds are cooked whole, it can be difficult to achieve the necessary reduction in antinutritional factors. However, if the seeds are treated to release their oil before or during cooking, the quantity of oil can be so great that the product cannot easily be handled. One way of dealing with this problem is to mix the oilseeds with cereal or pulses (eg. peas or beans) which absorb the released oil and maintain the mixture in a handleable state. However, it is not always desirable to mix oilseeds with cereals or pulses.

In the case of pulses and cereal feeds, it is common practice to grind before cooking to improve the

digestibility of the product. However, the grinding step means that it is not possible to produce a flaked cooked product, and flaked cereal feeds (and to a lesser extent flaked pulses) are commonly required.

We have now found a way in which these problems can be reduced or overcome and by which certain new animal feeds can now be made which have hitherto been impossible.

According to the present invention, there is provided a method of manufacturing a cooked animal feed from one or more oilseeds, pulses and/or cereals, which comprises passing the raw feed through a cracking roll prior to wet cooking.

In the case of oilseeds, the cracking roll is set to crack the seed case but not release any significant quantity of the oil. This cracking greatly facilitates the subsequent wet cooking and enables the water to permeate into the oilseeds to raise the temperature sufficiently to destroy the antinutritional factors. The oil is then released after the cooking step, and this is described hereinafter. In the case of pulses and cereals, the cracking rolls are either set to crack the pulse or cereal, or are set to reduce its size (eg. in the case of maize) but not so much that it cannot be flaked after cooking.

Thus, by the provision of cracking rolls appropriately set in accordance with the material being processed, great improvements can be achieved in the treatment both of oilseeds and of pulses and cereals.

The invention thus also includes apparatus for manufacturing a wet cooked animal feed from one or more oilseeds, pulses and/or cereals, which comprises a pair of cracking rolls and, downstream of the rolls, a wet cooker.

Preferably, the cracking rollers have up to about 6 flutes per inch, the flutes being generally helical. As will be clear to those skilled in the art, cracking rollers are similar to roller grinders except that cracking rollers have far fewer flutes and do not affect the oilseed or other material so severely. One general arrangement of cracking

rollers comprises a pair of rollers with their axes parallel and horizontal, with one axis offset from and above the other. The top roller is preferably rotated faster than the lower roller to provide a tearing effect on the material passed through the gap between the two rollers.

After the cracked oilseed has been cooked, it is treated to release its oil. There are several ways in which this can be done. Conveniently, the oilseed can be passed through flaking rollers and then into a screw expander. In the expander, the oil/husk/oilseed mix is heated and compressed, and finally expelled with a pressure drop which causes rupture of any remaining intact seeds. The full oilseed product may then be pelleted or otherwise processed as desired.

It is an important feature of the invention that certain new full fat oilseed products can be made. In particular, 100% cooked full fat sunflower, linseed and rapeseed can be made by this process. The sunflower product is conveniently produced in the form of a meal (by drying and cooling the cooked, expanded mixture, and finally crumbling to meal). The linseed product may also be in the form of meal. The rapeseed product may need the addition of a small quantity of a flow aid (such as silica) to render it conveniently handlable, because of the very high oil content of rapeseed. The invention thus includes these cooked full fat products per se, and other similar products such as lentils.

In the case of cereals and pulses, the cooked product can be immediately flaked if desired. Alternatively, it can be pressed into pellets or otherwise converted into meal in accordance with known procedures. The cooked flaked products are themselves new and constitute a further aspect of the present invention. Among the cereals and pulses which can be treated in accordance with the invention are wheat, barley, oats, maize, rye, peas and beans.

In the process of the invention as applied to

cereals and pulses, roller grinders can optionally be provided between the cracking rolls and the cooker if a flaked product is not required. In such cases, the cereal or pulse will be finely ground and will thus be more readily cooked. The cracking rolls still serve a useful purpose in effecting a preliminary reduction in size or cracking of the pulse or cereal before finer grinding. We prefer to use grinding rollers having 12 or more flutes per inch for the grinding process.

The method and apparatus of the invention can also advantageously be used for treating mixtures of raw materials. In the case of mixtures of oilseeds, cracking of the smallest seeds is necessary and, in that event, larger oilseeds mixed therewith may be opened sufficiently to release oil. However, the smaller seeds are cracked without any significant release of oil. Release of oil from the larger seeds will not be important provided the resulting mix can still readily be handled. Overall, as is always the case in the process of the invention, not all the oil in the oilseeds is released at cracking and usually, virtually none of it is released except in this special case. For mixtures of two or more cereals or two or more pulses, or cereals and pulses, the procedure is unchanged. Where a cooked flaked product is required, the cracking rolls must leave sufficient large size particles to provide for the formation of flake downstream of the cooker.

It is also possible, and indeed advantageous, to treat mixtures of oilseeds and cereals and/or pulses by the method of the invention. In such cases, the requirements for treating the oilseed are more important than the requirements for treating the cereal or pulse mixed therewith. Thus, the mixture will be treated to achieve the desired cracking of the oilseed regardless of the cereal or pulse (which will usually be larger in size than the oilseed). Exceptionally, it may be necessary to use some roller grinders downstream of the cracking rollers: thus, the cracking rollers may be used to reduce the size of the

pulse or cereal and the grinder rollers may then be used to grind the cereal or pulse and simultaneously to crack (only) the small oilseed.

The mixture containing the cracked oilseed is then cooked and subsequently treated to release all the oil. Finally, the mixture can be pelleted or otherwise as desired, ready for use.

The invention allows the direct preparation of virtually any mix of oilseed, pulse and/or cereal. Certain of these are new, in particular: mixtures containing full fat rapeseed and pea, with at least 50% rapeseed; mixtures containing more than 75% full fat cooked rapeseed (with cereal and/or pulse); mixtures of full fat cooked sunflower or linseed (or lentil) with cereal and/or pulse; mixtures of two or more cooked full fat oilseeds, optionally also with cereal and/or pulse. These novel products per se also constitute an aspect of the present invention.

A further major advantage of the present invention lies in its provision of apparatus whereby almost any and every feedstuff selected from oilseeds, cereals and pulses, including mixtures of two or more thereof, can be satisfactorily treated by wet cooking to provide a useful, safe and digestible animal feed. Thus, plant constructed in accordance with the invention can readily be switched to treat different mixes or single materials in the optimum way without expensive downtime for modification. In a preferred aspect, the invention thus includes apparatus for making a cooked animal feed from one or more of oilseed, cereal and pulse, which comprises cracking rolls and a wet cooker for the cracked product; the apparatus further including optional operable units including roller grinders between the cracking rolls and the cooker; and flaking rolls, an expander, a press, and a cooler dryer downstream of the cooker.

The individual steps in the processes of the invention are in essence known per se or otherwise plain to

those skilled in the art and no detailed explanation will therefore be given. It is to be understood that the particular apparatus or method used to carry out any step is not critical provided it achieves the intended result. We prefer to use, as the cooker, a hydrothermal reactor such as is available for this purpose from Amandus Kahl Nachfo., Hamburg. In this reactor, the material slowly descends under gravity whilst being heated indirectly and with live steam under pressure. Typical conditions are a residence time of about 40 to 45 minutes at 90° to 100°C and 2 bar pressure at about 20% moisture. However, actual conditions will vary somewhat depending of the exact nature of the product being cooked.

The cracked (and optionally ground) product is advantageously preconditioned before entering the cooker, a small conditioner into which live steam is injected to raise the temperature and moisture content quickly.

After cooking, a Kahl annular gap expander can advantageously be used.

In order that the invention may be more fully understood, embodiments thereof will now be described, by way of example only, with reference to the single accompanying drawing which is a schematic representation of one example of a plant for carrying out the process of the invention.

Referring to the drawing, the plant comprises a number of storage bins 1,2 (only two shown) for different raw materials, and a scale pan 3 therebelow to which material can be fed from respective bins by conveyors 4,5 for weighing. The weighed material is then conveyed to a feed hopper 6 and from thence into cracking rolls 7. For simplicity, various valves, screens and controls are not shown in the drawing.

From cracking rolls 7, the material passes onto conveyor 8 from whence it either passes direct to another conveyor 9, or it passes into roller grinders 10,11 and thence to conveyor 9.

The material now passes to a feed hopper 12 and from there into conditioner 13 into which live steam is passed via line 14. From the conditioner, the material passes through the cooker 15 and out onto conveyor 16. Live steam is supplied to the cooker via line 17. From conveyor 16, the material may either pass to lower conveyor 18, or it may pass through flaking rolls 19 and then to conveyor 18. From conveyor 18, the material either passes to expander 20 (fed with live steam 25) and thence to conveyor 21, or direct to conveyor 21, or directly to downstream of press 22 which is fed from conveyor 21.

Material then passes to cooler/dryer 23 and optionally to a crumbler 24 if meal is required.

EXAMPLE

Rapeseed 500 Kgs and Peas 500 Kgs were mixed and passed through cracking rolls set at a gap of .5mm and operated at a differential speed between the top and bottom roll of 1.25:1.0. The rapeseeds were cracked but there was only a trace of released oil. The mixture was then conditioned at 65°C for 2 minutes with live steam, and then passed into a hydrothermal cooker operated at 95°C for 45 minutes.

The wet cooked product was then passed through a screw expander operating at 140°C for 5 seconds. The existing mixture consisted of the free oil with cooked peas and rapeseed shells in a homogeneous fluid mass. This was then passed through flaking rollers to further liberate oil from the oilcells. The individual rollers in the flaking machinery are pushed together by hydraulics exerting a pressure of 500 lbs/square inch.

The mixture passed into a pelleting press to create a shape more conducive for cooling and drying. After the mixture is dried to a level of 9% the product is cooled to ambient temperature. During transport to storage the mixture is passed through a set of cracking rollers to reduce the pellet back to a meal.

This process applies to the following list of mixtures and or products;

- (a) Oilseeds alone.
- (b) Oilseed and pea or bean.
- (c) Oilseed and cereal.

The process for cereal or pulse is identical except the expander is by-passed and after the product has passed through the flaking machine it is not pelleted but dried and cooled in flake form. In transport to storage the flakes by-pass the cracking rolls previously used to reduce pellets back to meal.

CLAIMS:

1. A method of manufacturing a cooked animal feed from one or more oilseeds, pulses and/or cereals, which comprises passing the raw feed through a cracking roll prior to wet cooking.

2. A method according to claim 1, wherein the raw feed consists essentially of oilseeds and, upon passage through the cracking roll, the seeds are cracked without release of any significant quantity of oil.

3. A method according to claim 2, wherein the oil is released from the oilseeds at or after the cooking.

4. A method according to claim 3, wherein the oilseeds are passed through an expander to release the oil therefrom.

5. A method according to any of claims 1 to 4 wherein the raw feed comprises one or more of rapeseed, sunflower, linseed or lentils.

6. A method according to claim 5, wherein the raw feed consists of two or more oilseeds, and wherein the cracking roll set to crack the smaller oilseeds so that no significant amount of oil is released therefrom.

7. A method according to claim 1, wherein the raw feed consists essentially of one or more pulses and/or cereals.

8. A method according to claim 7, wherein the raw feed comprises one or more of wheat, barley, oats, maize, rye, peas and beans.

9. A method according to claim 7, wherein after cooking the feed is flaked.
10. A method according to claim 7 or 8 wherein the raw feed is passed through roller grinders after the cracking roll and before cooking.
11. A method according to claim 1, wherein the raw feed comprises a mixture of one or more oilseeds and at least one cereal and/or pulse.
12. A method according to claim 11, wherein the mixture comprises:
- (a) rapeseed;
 - (b) rapeseed and peas and/or beans;
 - (c) more than 75% rapeseed with at least one cereal and/or pulse;
 - (d) sunflower or linseed with at least one cereal and/or pulse;
 - (e) two or more oilseeds with at least one cereal and/or pulse.
13. A method according to claim 11 or 12, wherein the cooked mixture is flaked or pelleted.
14. A method according to claim 11 or 12, wherein the oil is released from the oilseeds at or after cooking.
15. A method according to claim 14 wherein the mixture is passed through an expander to release the oil from the oilseeds.
16. A method according to any preceding claim wherein the raw feed is passed through a cracking roll comprising a pair of fluted rollers with a narrow gap therebetween, the rollers being rotated to provide different surface speeds in

the gap to provide a tearing effect on the raw feed passing therethrough.

17. A method according to any preceding claim wherein the wet cooking is effected in a hydrothermal reactor supplied with steam.

18. A method of manufacturing a cooked animal feed from one or more oilseeds, pulses and/or cereals, substantially as herein described.

19. A cooked animal feed manufactured by the method of any of claims 1 to 16.

20. Apparatus for manufacturing a wet cooked animal feed from one or more oilseeds, pulses and/or cereals, which comprises a pair of cracking rolls and, downstream of the rolls, a wet cooker.

21. Apparatus according to claim 19, which further includes an expander downstream of the cooker.

22. Apparatus according to claim 19 or 20, which also includes, downstream of the cooker, flaking rolls, a press and/or a cooler dryer.

23. Apparatus for manufacturing a wet cooked animal feed from one or more oilseeds, pulses and/or cereals, substantially as herein described with reference to the accompanying drawing.

24. Wet cooked 100% full fat sunflower, linseed or rapeseed.

25. Wet cooked flake cereal and/or pulse.

26. Wet cooked full fat mixture of rapeseed and pea.

27. A wet cooked full fat mixture of full fat rapeseed, with at least one cereal and/or pulse, the rapeseed constituting more than 75% by weight of the mixture.
28. A wet cooked full fat mixture of sunflower and/or linseed, with at least one cereal and/or pulse.
29. A well cooked full fat mixture of at least two oilseeds.
30. A mixture according to claim 28 which also contains at least one cereal and/or pulse.
31. A wet cooked material according to any of claims 23 to 29 in the form of meal, pellets or flake.
32. An animal feed made from a wet cooked material according to any of claims 23 to 30.

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Patents Act 1977
Examiner's report to the Comptroller under Section 17
(The Search report)

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Relevant Technical Fields

- (i) UK Cl (Ed.L/M) A2B: BMR1, BMR5; BKC; BMA3;
 BMA9; AQ2; Q3A; Q3B; Q4; Q7B
- (ii) Int Cl (Ed.5) B02B; A23K; A23L; A23N

Search Examiner
 B J GARDNER

Date of completion of Search
 18 OCTOBER 1993

Databases (see below)

(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

Documents considered relevant following a search in respect of Claims :-
 1 TO 32

(ii) NONE

Categories of documents

X: Document indicating lack of novelty or of inventive step.

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Category	Identity of document and relevant passages		Relevant to claim(s)
X	GB 1101821	(ALTMAN) - see whole document	25 and 30 at least
X	GB 1014352	(CEREAL PROCESSING CO LTD) - see whole document	1,25 at least
X	GB 1012258	(COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION) - see whole document	1 and 25 at least
X	EP 0042545	(FEIKENS) - see whole document	1 and 25 at least
X	US 4543264	(LAND O'LAKES INC) - see whole document	24 and 29 at least

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